UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 CFR 1.53(b))

Attorney Docket No.	684.2173 CI
First Named Inventor or Application Identifier	TAKEHIKO SUZUKI, ET AL.
Express Mail Label No.	

APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents.

ADDRESS TO: Assistant Commissioner for Patents
Box Patent Application
Washington, DC 20231

1. [X] Fee Transmittal Form *(Submit an original, and a duplicate for fee processing)*
2. [X] Specification — *Total Pages* 27
3. [X] Drawings *(35 USC 113)* — *Total Sheets* 5
4. [X] Oath or Declaration *Total Pages* 2
   - a. [ ] Newly executed (original or copy)
   - b. [ ] Unexecuted for information purposes
   - c. [X] Copy from a prior application (37 CFR 1.63(d)) *(for continuation/divisional with Box 17 completed)* ***[Note Box 5 below]***
     - i. [ ] DELETION OF INVENTOR(S) Signed Statement attached deleting inventor(s) named in the prior application, see 37 CFR 1.63(d)(2) and 1.33(b).
5. [X] Incorporation By Reference *(useable if Box 4c is checked)* The entire disclosure of the prior application, from which a copy of the oath or declaration is supplied under Box 4c, is considered as being part of the disclosure of the accompanying application and is hereby incorporated by reference therein.
6. [ ] Microfiche Computer Program *(Appendix)*
7. Nucleotide and/or Amino Acid Sequence Submission *(if applicable, all necessary)*
   - a. [ ] Computer Readable Copy
   - b. [ ] Paper Copy (identical to computer copy)
   - c. [ ] Statement verifying identity of above copies

ACCOMPANYING APPLICATION PARTS

8. [ ] Assignment Papers (cover sheet & document(s))
9. [ ] 37 CFR 3.73(b) Statement *(when there is an assignee)* [ ] Power of Attorney
10. [ ] English Translation Document *(if applicable)*
11. [X] Information Disclosure Statement (IDS)/PTO-1449 [X] Copies of (3) IDS Citations
12. [X] Preliminary Amendment
13. [X] Return Receipt Postcard (MPEP 503) *(Should be specifically itemized)*
14. [ ] Small Entity Statement(s) [ ] Statement filed in prior application Status still proper and desired
15. [ ] Certified Copy of Priority Document(s) *(if foreign priority is claimed)*
16. [X] Other: Letter Forwarding Corrected Sheets of the Drawings along with five sheets of corrected formal drawings.

17. If a CONTINUING APPLICATION, *check appropriate box and supply the requisite information:*
[X] Continuation [ ] Divisional [ ] Continuation-in-part (CIP) of prior application No. 08/521,835

18. CORRESPONDENCE ADDRESS

[X] Customer Number or Bar Code Label — 05514 (Insert Customer No. or Attach bar code label here) — or [ ] Correspondence address below

NAME					
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City		State		Zip Code	
Country		Telephone		Fax	

CLAIMS	(1) FOR	(2) NUMBER FILED	(3) NUMBER EXTRA	(4) RATE	(5) CALCULATIONS
	TOTAL CLAIMS (37 CFR 1.16(c))	25-20 =	5	X $ 18.00 =	$ 90.00
	INDEPENDENT CLAIMS (37 cfr 1.16(b))	2-3 =	0	X $ 78.00 =	$ 0
	MULTIPLE DEPENDENT CLAIMS (if applicable) (37 CFR 1.16(d))			$260.00 =	$ 260.00
				BASIC FEE (37 CFR 1.16(a))	$ 690.00
			Total of above Calculations =		$1,040.00
	Reduction by 50% for filing by small entity (Note 37 CFR 1.9, 1.27, 1.28).				
				TOTAL =	$1,040.00

19. Small entity status

a. ☐ A Small entity statement is enclosed

b. ☐ A small entity statement was filed in the prior nonprovisional application and such status is still proper and desired.

c. ☐ Is no longer claimed.

20. ☒ A check in the amount of $ 1,040.00 to cover the filing fee is enclosed.

21. ☐ A check in the amount of $ _____ to cover the recordal fee is enclosed.

22. The Commissioner is hereby authorized to credit overpayments or charge the following fees to Deposit Account No. 06-1205:

a. ☒ Fees required under 37 CFR 1.16.

b. ☒ Fees required under 37 CFR 1.17.

c. ☐ Fees required under 37 CFR 1.18.

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT REQUIRED	
NAME	William M. Wannisky Registration No. 28,373
SIGNATURE	William M Wannisky
DATE	June 20, 2000

WMW/kas/llp

684.2173 CI

PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:	)	
	:	Examiner: Unassigned
TAKEHIKO SUZUKI, ET AL.	)	
	:	Group Art Unit: Unassigned
Appln. No.: Unassigned (Continuation of Appln. No. 08/521,835 filed August 31, 1995)	) :)	
Filed: June 20, 2000	) :	
For: AN IMAGE FORMING APPARATUS FOR CONTROLLING TRANSFER INTENSITY BY DETECTING TONER TEST IMAGES	) :) :	June 20, 2000

Assistant Commissioner for Patents
BOX PATENT APPLICATION
Washington, DC 20231

PRELIMINARY AMENDMENT

Sir:

Prior to examination on the merits, please amend the above-identified application as follows:

IN THE SPECIFICATION:

Please amend the specification as follows:

Page 1

Insert as the first line(s) of the specification, as follows:

--This is a continuation application of Application No. 08/521,835, filed August 31, 1995.--.

Line 13, change "ambience change," to --changes in ambient conditions,--; and

Line 22, delete "f".

Page 2

Line 4, change "&g&" to --γ--.

Page 3

Line 2, change "ambience" (both occurrences) to --ambient condition--;

Line 4, after "control" insert --being--; and

Line 8, change "overage" to --excess--.

Page 4

Line 21, change "btjj" to --between--; and

Line 26, change "s" to --a--.

Page 8,

Line 9, change "a" to --an--.

Page 9

Line 20, change "layer 23 and the dielectric layer 23. This" to --layer 23.--;

Line 21, delete "is the reason."; and

Line 27, change "become" to --becomes--.

Page 11

Line 26, after "5.5", insert --mm--.

Page 12

Line 1, change "thickens" to --thickness-- and change "75mm" to --75μ--; and

Line 25, change "ambience" to --ambient condition--.

Page 13

Line 2, change "ambience" to --ambient condition--;

Line 6, change "ambience" to --ambient condition-- and after "resistance" delete --,-- (comma);

Line 9, change "ambience," to --ambient condition,--;

Line 20, change "temperature normal" to --temperature/normal-- and change "ambience" to --ambient condition--;

Line 23, change "ambience," to --ambient condition,--; and

Line 25, delete "the".

Page 14

Line 7, change "ambience," to --humidity ambient conditions,--;

Line 8, change "ambience," to --humidity ambient conditions,--;

Line 9, change "ambience." to --humidity ambient conditions.--;

Line 10, change "Table" (second occurrence" to --Figure--;

Line 17, change "not" to --no--;

Line 24, change "ambience," (both occurrences) to --humidity ambient conditions,--; and

Line 25, change "ambience." to --humidity ambient conditions.--.

Page 15

Line 1, change "condition." to --conditions.--;

Line 8, change "5.5" to --5.5 mm--; and

Line 10, change "thickens" to --thickness-- and change "75mm" to --75μ--.

Page 16

Lines 2 through 3, delete entire lines and insert --control process for Dmax control, wherein a voltage VD_{max}, and V_{HT} satisfy:--; and

Line 27, after "With" insert --a--.

Page 17

Line 10, change "the the" to --the--;

Line 12, change "preferab" to --preferable--;

Line 15, change "ambience," to --ambient conditions,--;

Line 24, change "5.5" to --5.5 mm on--; and

Line 26, change "thickens" to --thickness-- and change "75mm" to --75μ--.

IN THE ABSTRACT:

Please amend the Abstract as follows:

Page 27,

Line 3, change "means" to --unit--;

Line 8, change "density" to --a density--; and

Line 9, change "means" to --unit--.

IN THE CLAIMS:

Please cancel Claims 1 through 28 without prejudice to or disclaimer of the subject matter recited therein.

Please add the following claims:

29. An image forming apparatus comprising:

an image bearing member;

image forming means for forming a toner image on said image bearing member, wherein the toner image is transferred onto a transfer medium from said image bearing member;

density detecting means for detecting a density of the toner image transferred to the transfer medium; and

image forming condition control means for controlling an image forming condition by said image forming means based on the detection output of said density detection means,

wherein a transfer intensity is changeable in accordance with a density of the other image for density detection formed on said image bearing member by said image forming means when the toner image for density detection is transfer from said image bearing member to the transfer medium.

30. An apparatus according to Claim 29, wherein the transfer intensity when the toner image for density detection has a maximum density image formed on said image bearing member by said image forming means is transferred onto the transfer medium than when the toner image for density detection having a halftone density image formed on said image bearing member by said image forming means is transferred onto the transfer medium.

31. An apparatus according to Claim 29 or 30, wherein said image forming means includes exposure means for exposing a surface of said image bearing member, which has been electrically charged to in accordance with image information with an exposure amount, which is changeable in accordance with the density of the toner image formed on said image bearing member by said image forming means.

32. An apparatus according to Claim 31, wherein a surface potential of said image bearing member exposed by said exposure means is changeable in accordance with a density of the total image for density detection to be formed on said image bearing member by said image forming means.

33. An apparatus according to Claim 29 or 30, wherein the transfer intensity when the toner image for density detection is transferred onto the transfer medium is changeable in accordance with a tone gradation level of the toner image formed on said image bearing member by said image forming means.

34. An apparatus according to Claim 29, wherein said image forming means includes exposure means for exposing a surface of said image bearing member which has been electrically charged to in accordance with image information with an exposure amount which is changeable in accordance with the density of the toner image for density detection to be formed on said image bearing member by said image forming means.

35. An apparatus according to Claim 33, wherein said image forming means includes exposure means for exposing a surface of said image bearing member which has been electrically charged to in accordance with image information with an exposure amount which is changeable in accordance with the density of the toner image for density detection to be formed on said image bearing member by said image forming means.

36. An apparatus according to Claim 34 or 35, wherein a surface potential of said image bearing member exposed by said exposure means is changeable in accordance with a density of a total image to be formed on said image bearing member by said image forming means.

37. An apparatus according to Claim 29, further comprising transfer means supplied with a voltage to transfer the toner image, wherein the transfer intensity is a voltage supplied to said transfer means.

38. An apparatus according to Claim 29, further comprising ambient condition detecting means for detecting an ambient condition, wherein the transfer intensity is controlled on the basis of an output of said ambient condition detecting means.

39. An apparatus according to Claim 38, wherein said ambient condition detecting means detects temperature.

40. An apparatus according to Claim 38 or 39, wherein said ambient condition detecting means detects humidity.

41. An apparatus according to Claim 29, further comprising image forming condition control means for controlling an image forming condition by said image forming means based on the detection output of said density detecting means.

42. An apparatus according to Claim 41, further comprising developing means for developing a latent image formed on said image bearing member, wherein said image forming condition control means controls a voltage applied to said developing means on the basis of the detection output of said density detecting means.

43. An image forming apparatus comprising:

an image bearing member;

image forming means for forming a toner image, wherein the toner image is transferred onto a transfer medium from said image bearing member;

density detecting means for detecting a density of the toner image for density detection transferred onto the transfer medium;

ambient condition detecting means for detecting an ambient condition; and

control means for controlling a transfer intensity upon transfer of the toner image onto the transfer medium.

44. An apparatus according to Claim 43, wherein said ambient condition detecting means detects temperature.

45. An apparatus according to Claim 43 or 44, wherein said ambient condition detecting means detects humidity.

46. An apparatus according to Claim 43, further comprising transfer means supplied with a voltage to transfer the toner image, wherein the transfer intensity is a voltage supplied to said transfer means.

47. An apparatus according to Claim 43, further comprising image forming condition control means for controlling an image forming condition by said image forming means based on the detection output of said density detecting means.

48. An apparatus according to Claim 47, further comprising developing means for developing a latent image formed on said image bearing member, wherein said image forming condition control means controls a voltage applied to said developing means on the basis of the detection output of said density detecting means.

REMARKS

This is a continuation application of Application No. 08/521,835, filed August 31, 1995.

Claims 29 through 48 are presented for examination, with Claims 29 and 43 being the only independent claims. Claims 1 through 28 have been canceled. Claims 29 through 47 are newly presented to accord Applicants an additional scope of protection. It is respectfully submitted that no new matter has been added.

The specification, Abstract, have been amended to conform to amendments made in the parent application. Again, it is respectfully submitted that no new matter has been added.

Also filed concurrently herewith is a Letter Forwarding Corrected Sheets of the Drawings, along with five sheets of formal drawings, which were filed in the above-referenced parent application.

In addition, enclosed is an Information Disclosure Statement Under along with Form 1449 citing documents that were cited in the parent application.

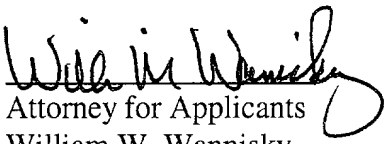
Applicants claim priority under 35 U.S.C. § 119 based upon Japanese Priority Application No. 206789 filed August 31, 1994, and respectfully requests acknowledgment of this claim for priority and of receipt of the certified copy of the priority document, which were filed December 15, 1995, in the parent application.

It is respectfully submitted that the present application is in condition for allowance.

Applicants request favorable consideration and early passage to issuance of the above-identified application at the Examiner's earliest convenience.

Applicants' undersigned attorney may be reached in our Washington, D.C. office by telephone at (202) 530-1010. All correspondence should continue to be directed to our below-listed address.

Respectfully submitted,



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AN IMAGE FORMING APPARATUS

FIELD OF THE INVENTION AND RELATED ART

The present invention relates to an image forming apparatus wherein a toner image is transferred from an image bearing member such as photosensitive drum onto a transfer material carried on a transfer material carrying member such as transfer drum, or transfer belt.

Generally, in a color image forming apparatus of electrophotographic type, a positive color tone is not provided if the image density variations due to various conditions such as ambience change, number of prints.

Therefore, in order to discriminate the circumstance during image formation, a toner image (patch) for maximum density (Dmax) detection for each color toner is formed on photosensitive drum as a test image, and the density thereof is detected by an optical sensor. The detection result is fed back to the image forming condition such as developing bias to maintain the Dmax for each toner at a predetermined f level maximum density control (Dmax control). In order to provide a high quality image, the Dmax for each toner is desirably maintained at a predetermined level, and in addition, the tone gradient reproduction is also desirably correct. In view of this, a

plurality of half-tone patches from low density to high density are formed for each toner as test images, and the densities are detected. On the basis of the detection results, a correction (so-called &g& correction) is effected to provide a linear relation between the image signal and the resultant image density (half-tone control).

On the other hand, in order to downsize the main assembly of the device, diameter reduction of the photosensitive drum is effective. This is because the circumferential length of the transfer drum has to be at least the length of the transfer material usable with the apparatus.

In order to eliminate the necessity of the provision of a sensor around the photosensitive drum, it has been proposed to transfer a patch image formed on the photosensitive drum onto the transfer drum and then to detect the transferred patch image by a sensor provided adjacent the transfer drum.

However, there arises a problem that the first sheet after the density control with the patch image on the transfer material drum, involves back side contamination.

The cause has been found as being that the patch image formed for the density control is not completely cleaned with the result that the transfer drum is contaminated after the density control.

There is a problem that under the low humidity ambience or high humidity ambience, correct image density, or color tone is not provided despite the density control carried out.

This is because the correct density control is not carried out because of the deterioration of the transfer action due to the shortage of the transfer charge or the overage of the transfer charge resulting in penetration due to the change of the patch toner polarity.

That is, when the image is transferred with low transfer efficiency as a result of transfer defect or penetration (thin image transfer), the density control increases the developing bias despite the fact that the satisfactory development is effected, resulting in the higher density developed image. Thus, positive image density is not provided, and the tone gradient reproducibility becomes poor.

SUMMARY OF THE INVENTION

Accordingly, it is a principal object of the present invention to provide a control system for an image forming condition of image forming means on the basis of detection of a toner image for density detection.

It is another object of the present invention to provide a transfer system for properly transferring

the toner image for the density detection onto the transfer material carrying member.

It is a further object of the present invention to provide a transfer system for a toner image for proper density detection despite the ambience condition change.

While the invention has been described with reference to the structures disclosed herein, it is not confined to the details set forth and this application is intended to cover such modifications or changes as may come within the purpose of the improvements or the scope of the following claims.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is an illustration of an image forming apparatus according to embodiment 1 of the present invention.

Figure 2 is a major part illustration of a transfer device of an image forming apparatus according to embodiment 1. Figure 3 is a graph showing a relation btjj a transfer current and Q/M of toner after the transfer.

Figure 4 is an illustration of an image forming apparatus according to embodiment 2 of the present invention.

Figure 5 is s graph showing a transfer efficiency (for temperature/humidity, respectively)

during normal print

Figure 6 is a graph showing transfer efficiency (for temperature/humidity, respectively during density detection.

Figure 7 is a graph showing transfer efficiency (for respective PWM signal data) during density detection.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Figure 1 is a sectional view of a full-color image forming apparatus of an electrophotographic type according to an embodiment of the present invention.

In the color image forming apparatus, an image bearing member 3 in the form of an electrophotographic photosensitive drum is rotated in a direction indicated by the arrow, and is charged uniformly by charging means 10 during the rotation, and thereafter, it is subjected to a light image projection by a laser exposure device 11 or the like so that the electrostatic latent image is formed on the photosensitive drum 3. The latent image is developed into a visualized image, namely toner image by developing devices 1a, 1b, 1c, 1d containing color developers such as yellow (Y), magenta (M), cyan (C), developers, for example, carried on a rotatable supporting member.

In this example, reverse development is used

wherein the toner is deposited on the low potential portion provided by the light projection.

On the other hand, the transfer material 7 is fixed by a gripper 5 on a transfer device 2, having a drum type transfer material carrying member. More particularly, it is electrostatically attracted on the transfer drum 2 by an attracting device 8. The attracting device 8 comprises, as shown in Figure 2, an aluminum core metal 21, an elastic layer 22, thereon and a dielectric layer 23 for attracting the transfer material on the surface thereof. The toner image on the photosensitive drum 3 is transferred onto a transfer material 7 wound around the transfer device, namely the transfer drum 2 in this example by applying a voltage between the aluminum core metal 21 functioning also as a transfer electrode and the elastic layer 22 from the voltage source 17.

More particularly, an electrostatic latent image formed on the photosensitive drum 3 by the exposure based on an image signal for a first color, is visualized by a developing device 1a accommodating the yellow (Y) developer, and thereafter, it is transferred onto the transfer material 7 carried on the transfer drum 2. Subsequently, the remaining developer on the photosensitive drum 3 is removed by a cleaner 12, and thereafter, an electrostatic latent image for the second color is formed on the

photosensitive drum 3 by the exposure based on an image signal for the second color. It is visualized by a developing device 1b having a magenta (M) developer, for example. Then, it is overlyingly on transferred on the transfer material 7 on the transfer drum 2 having the yellow visualized image. Subsequently, the same process is repeated, and the cyan (C), and black (Bk) toner images are overlyingly transferred onto the transfer material 7 on the transfer drum 2. Thereafter, the transfer material 7 is discharged by a separation discharger 6, and is separated from the transfer drum 2 by a separation claw 14, and the image is fixed by a fixing device 4 into a permanent image.

The transfer drum 2 after the transfer material 7 separation, is cleaned by a transfer member cleaner 13 so that the developer is removed from the surface thereof, and is discharged by a discharger 9 to be electrically initialized.

In this embodiment, the density detection is carried out in the following manner. First, a density detection patch image (patch) of the maximum density (Dmax) of yellow (Y) is formed on the photosensitive drum 3. The patch is transferred onto the transfer drum 2, and the density of the patch is detected by a density sensor 15. Subsequently, a patch image for the Dmax detection is formed with magenta (M) color toner on the photosensitive drum 3, and is transferred onto

the transfer drum at a position different from that of the Y toner patch. The density of the patch is detected by the density sensor 15. Similarly, the densities of the cyan (C), and black (Bk) toner images are detected to effect the Dmax control. The order of the colors of the patch images for the density detection may be different.

On the basis of the output of the density sensor, the image forming condition such as a application voltage, or developing bias of the charger 10 is controlled.

In this embodiment, a transfer intensity upon the transfer of the density detection patch image onto the transfer drum 2, is made smaller than the transfer intensity upon the transfer of the toner image onto the transfer material 7 carried on the transfer drum 2.

Therefore, the patch image can be easily removed.

In this embodiment, in order to reduce the transfer intensity, the transfer bias V_{pat} applied from the voltage source 17 upon the density detection operation is made smaller than the transfer bias V_{tr} applied from the voltage source 17 upon the transfer of the toner image onto the transfer material.

Preferably, $V_{pat} \leq (4/5)V_{tr}$ is satisfied.

Conventionally, the transfer bias upon

density detection is the same as the transfer bias upon the normal print. However, the total electrostatic capacity of the nip is larger during the density detection than during the normal print, corresponding to the absence of the transfer material, and therefore, a larger transfer current flows during density detection if the same bias voltage is applied.

In a transfer drum type as in this embodiment, the larger the transfer current (positive) as shown in Figure 3, the larger the charge of the opposite polarity (negative) from the transfer charge is induced in the toner, with the result of higher Q/M ($-\mu C/g$) of the toner after the transfer increases.

By application of the charge (positive) of the same polarity as the transfer onto the rear surface of the dielectric layer 23, the air is ionized in the small clearance downstream of the nip between the transfer drum 2 and the photosensitive drum 3, so that negative charge is applied on the surface of the dielectric layer 23 and the dielectric layer 23. This is the reason.

Thus, with increase of the negative charge of the toner and the positive charge on the dielectric layer 23 rear surface, the Coulomb force between the toner and the transfer drum dielectric layer 23 increases, and therefore, the cleaning property become poor.

The following Table 1 shows a relation between the transfer bias for the first color density detection and cleaning property :

TABLE 1 (First Color)

Vtr1=1000V

Transfer Bias (V)	300	500	800	900	1000	1200
Cleaning Property	G	G	G	F	NG	NG

G: good

F: fair

NG: No good

Here, upon 1000V of transfer bias, the transfer current is 14.1μA, and upon 900V, the current is 10.6μA, and upon 800V, it is 7.2μA. It is understood that with the increase of the transfer current, the Q/M of the toner after the transfer increases with the result of the poor cleaning property. Tables 2-4 show relations between the transfer biases for the density detections for the second to the fourth colors and the cleaning property.

TABLE 2 (Second color)

VTr2 = 1200V

Transfer Bias (V)	550	900	1000	1100	1200	1400
Cleaning Property	G	G	F	NG	NG	NG

TABLE 3 (Third color)
VTr3 = 1400V

Transfer Bias (V)	600	1100	1200	1300	1400	1600
Cleaning Property	G	G	F	NG	NG	NG

TABLE 4 (Fourth color)
VTr4 = 1400V

Transfer Bias (V)	650	900	1200	1400	1600	1800
Cleaning Property	G	G	G	F	NG	NG

It has been found that there is an interrelation between the transfer bias and the cleaning property for each color upon the density detection and the transfer bias upon the normal print, more particularly, if the transfer bias during the density detection is not more than 4/5 of the transfer bias during the normal print, the cleaning property is good. In this embodiment, the photosensitive drum is of OPC having a negative charging property. It comprises a charge generating layer and the charge transfer layer having a thickness of 25 microns. The transfer drum comprises a core metal 21 of aluminum as a transfer electrode, an elastic member 22 having a thickness of 5.5 aluminum and a volume resistivity of 10^4Ohm.cm or smaller, and a dielectric member 23

having a thickens of 75mm and a volume resistivity of10^{14}-10^{16}Ohm.cm. The transfer bias during the normal print was 1000V, 1200V, 1400V, 1600V, for the first to fourth colors, and the transfer bias upon density detection was 500V, 550V, 600V, 650V, by which the cleaning was easy, and the back side contamination of the first sheet after the density control could be prevented.

If the transfer bias during the transfer of the density detection patch is too small, the transfer efficiency of the patch image is low, and therefore, the $V_{pat} \geq (1/5)V_{tr}$ is preferable.

In this embodiment, the transfer biases are different during the density detection and the normal print, but the DC current to be supplied from the voltage source 17 during the density detection may be made smaller than the normal print.

Embodiment 2

Referring to Figure 4, a second embodiment will be described. The same reference numerals as in the first embodiment are assigned to the elements having the corresponding functions, and detailed descriptions thereof are omitted for simplicity. In this embodiment, the temperature/humidity of the ambience is detected by an ambient condition detecting sensor 16, and the transfer bias is changed on the basis of the detection result.

In this embodiment, even if the temperature/humidity of the ambience changes, the transfer of the patch image during the density detection is made optimum and the proper density control is assured. If the temperature/humidity of the ambience changes, the resistance, and the electrostatic capacity of the dielectric layer 23 and the like change. For example, under a low temperature and low humidity ambience, the resistance of the dielectric layer 23 is high, and the electrostatic capacity is low. The resistance and electrostatic capacity of the transfer material 7 changes. In this embodiment, the toner is transferred onto the transfer drum 2 by the potential difference between the photosensitive drum 3 and the transfer drum 2. Therefore, when the electrostatic capacity at the transfer position decreases, the potential difference between the photosensitive drum 3 and the transfer drum 2 reduces as compared with the case of the normal temperature normal humidity ambience even if the same bias is applied. So, improper transfer results. On the contrary, under a high temperature and high humidity ambience, the potential difference is large with the result of discharge at the transfer position, and therefore, the improper transfer.

In this embodiment, in order to provide a high transfer efficiency irrespective of the ambient

condition change, the temperature and humidity in the device are detected by a sensor 16, and the transfer bias is controlled on the basis of the detection result.

For example, as shown in Figure 5, during the normal print, the transfer bias for the first color is 800(V), under 38°C, 80% ambience, and 1000(V), under 23°C, 60% ambience, and 1200(V) under 15°C, 10% ambience.

As shown in Table 5 and Table 5, the transfer bias for the density detection is controlled on the basis of the detection result of the sensor 16.

This is because there is no transfer material 7 at the transfer position during the density detection, but the electrostatic capacity of the dielectric layer 23 changes depending on the ambience.

During the density detection, there is not transfer material 7 in the transfer position, and therefore, the total electrostatic capacity is larger than during the normal print operation.

Accordingly, as shown in Table 5, for example, during the density detection, transfer bias, for the first color is 350(V), under 30°C, 80% ambience, and 500(V), under 23°C, 60% ambience, and 700(V) under 15°C, 10% ambience.

In this embodiment, transfer bias for the density detection is smaller than the transfer bias

for the normal print under the same ambient condition.

In this embodiment, the photosensitive drum is of OPC having a negative charging property. It comprises a charge generating layer and the charge transfer layer having a thickness of 25 microns. The transfer drum comprises a core metal 21 of aluminum as a transfer electrode, an elastic member 22 having a thickness of 5.5 core metal 21 and a volume resistivity of 10^4Ohm.cm or smaller, and a dielectric member 23 having a thickens of 75mm and a volume resistivity of 10^{14}-10^{16}Ohm.

TABLE 5

	15°C10%	23°C60%	30°C80%
Bias for first color	700V	500V	350V
Bias for second color	770V	550V	380V
Bias for third color	840V	600V	410V
Bias for fourth color	910V	650V	440V

Embodiment 3

The same reference numerals as in the foregoing embodiments are assigned to the elements having the corresponding functions, and detailed descriptions thereof are omitted for simplicity. In

this embodiment, density control process includes a first control process for Dmax control, and a second, and the V_{HT} satisfy:

$$VDmax > V_{HT}$$

In this embodiment, the transfer is optimized by both of the Dmax control and the half-tone control. More particularly, in the Dmax control, one patch image data corresponding to a certain density, FOH of PWM signal, for example, is formed with varied developing bias. In the half-tone control, a plurality of low density patch images corresponding to 10H, 20H, 40H, 80H, are formed. At this time, the patch images of different PWM signal data have different latent image potentials, since the exposure amounts are different. In this embodiment, the latent image potential when the PWM signal data is FOH, is -220V, and -580V when it is 10H. In this embodiment, the toner is transferred onto the transfer drum by the potential difference between the photosensitive drum and the transfer drum. Therefore, if the latent image potential is different, the most preferable transfer bias is different.

Figure 7 shows a relation between the transfer bias and the transfer efficiency upon the density detection relative to different PWM signal data.

With decrease of the PWM signal, the most

preferable transfer bias decreases, and with the increase of the PWM signal, the most preferable transfer bias increases.

If only the patches for 10H to 80H are looked at, the most preferable transfer is possible with the same bias voltage. Therefore, in this embodiment, the transfer bias during the Dmax control is 500V, and the transfer bias during the half-tone control is 350V, by which the transfer for both can be optimized. The density control is proper, and the the correct image density, and color tone are provided.

Most preferab transfer biases may be set for the PWM signals of 10H to 80H, respectively.

It is preferable to detect the temperature/humidity of the ambience, and the transfer bias is controlled on the basis of the result of the detection.

In this embodiment, the photosensitive drum is of OPC having a negative charging property. It comprises a charge generating layer and the charge transfer layer having a thickness of 25 microns. The transfer drum comprises a core metal 21 of aluminum as a transfer electrode, an elastic member 22 having a thickness of 5.5 core metal 21 and a volume resistivity of10^4Ohm.cm or smaller, and a dielectric member 23 having a thickens of 75mm and a volume resistivity of10^{14}-10^{16}Ohm.. The description is

omitted for the second and subsequent colors, since there are the same tendencies.

While the invention has been described with reference to the structures disclosed herein, it is not confined to the details set forth and this application is intended to cover such modifications or changes as may come within the purposes of the improvements or the scope of the following claims.

WHAT IS CLAIMED IS:

1. An image forming apparatus comprising :

an image bearing member for carrying a toner image;

an image forming means for forming a toner image on said image bearing member;

a transfer material carrying member, for carrying a transfer material, wherein the toner image is transferred onto a transfer material carried on said transfer material carrying member or onto said transfer material carrying member;

density detecting means for detecting a density of the toner image transferred to said transfer material carrying member;

wherein a transfer intensity is smaller when the toner image for density detection is transferred onto said transfer material carrying member than when the toner image is transferred onto the transfer material carried on said transfer material carrying member.

2. An apparatus according to Claim 1, further comprising transfer means supplied with a voltage to transfer the toner image, wherein the transfer intensity is a voltage supplied to said transfer means.

3. An apparatus according to Claim 2, wherein said transfer means includes an electroconductive member for supporting the transfer material carrying member on the side opposite from a side for carrying the transfer material, and the voltage is applied to the electroconductive member.

4. An apparatus according to Claim 2 or 3, wherein the voltage applied to said transfer means V_{tr}, when the toner image is transferred onto the transfer material carried onto the transfer material carrying member, and the voltage applied to said transfer means V_{pat} when the toner image for the density detection is transferred onto the transfer material carrying member, satisfy $(1/5)\ xV_{tr} \leq V_{pat} \leq (4/5)\ xV_{tr}$.

5. An apparatus according to Claim 1, further comprising ambient condition detecting means for detecting an ambience condition, wherein the transfer intensity is controlled on the basis of of an output of said detector.

6. An apparatus according to Claim 5, wherein the transfer intensity is smaller when the toner image for the density detection is transferred onto said transfer material carrying member than when the toner

image is transferred onto the transfer material carried on said transfer material carrying member, provided that the output of said ambient condition detecting means is the same.

7. An apparatus according to Claim 1 or 6, wherein first and second density detection toner images of different densities are formed on said image bearing member, and the transfer intensity is different between when the first is transferred from said image bearing member onto said transfer material carrying member and when the second density detection toner image is transferred from said image bearing member onto said transfer material carrying member.

8. An apparatus according to Claim 1, wherein an image forming condition of said image forming means is controlled on the basis of an output of said density detecting means.

9. An apparatus according to Claim 3, wherein said electroconductive member includes a base member and an elastic layer between the base member and said transfer material carrying member.

10. An apparatus according to Claim 1, wherein a plurality of said toner images are

sequentially overlaid on said transfer material carrying member.

11. An image forming apparatus comprising :

an image bearing member for carrying a toner image;

image forming means for forming the toner image on said image bearing member;

a transfer material carrying member, for carrying a transfer material, wherein the toner image is transferred onto said transfer material carrying member, or onto a transfer material carried on said transfer material carrying member.

density detecting means for detecting a density of the toner image transferred onto said transfer material carrying member;

ambient condition detecting means for detecting ambience condition;

wherein a transfer intensity is controlled on the basis of an output of said ambient condition detecting means when the toner image for the density detection is transferred onto said transfer material carrying member.

12. An apparatus according to Claim 11, wherein said ambient condition detecting means includes temperature sensing means for measuring a

temperature of ambience.

13. An apparatus according to Claim 11 or 12, wherein said ambient condition detecting means includes humidity detecting means for measuring a humidity of ambience.

14. An apparatus according to Claim 11, further comprising transfer means supplied with a voltage to transfer the toner image, wherein the transfer intensity is a voltage supplied to said transfer means.

15. An apparatus according to 13, wherein said transfer means includes an electroconductive member for supporting the transfer material carrying member on the side opposite from a side for carrying the transfer material, and the voltage is applied to the electroconductive member.

16. An apparatus according to Claim 11, wherein first and second density detection toner images of different densities are formed on said image bearing member, and the transfer intensity is different between when the first is transferred from said image bearing member onto said transfer material carrying member and when the second density detection

toner image is transferred from said image bearing member onto said transfer material carrying member.

17. An apparatus according to Claim 15, wherein said electroconductive member includes a base member and an elastic layer between the base member and said transfer material carrying member.

18. An apparatus according to Claim 15, wherein an image forming condition of said image forming means is controlled on the basis of an output of said density detecting means.

19. An apparatus according to Claim Claim 11, wherein a plurality of the toner images are sequentially overlaid on said transfer material carrying means.

20. An image forming apparatus comprising :

an image bearing member for carrying a toner image;

image forming means for forming the toner image on said image bearing member;

a transfer material carrying member, for carrying a transfer material, wherein the toner image is transferred onto said transfer material carrying member, or onto a transfer material carried on said

transfer material carrying member.

density detecting means for detecting a density of the toner image transferred onto said transfer material carrying member;

wherein first and second density detection toner images of different densities are formed on said image bearing member, and the transfer intensity is different between when the first is transferred from said image bearing member onto said transfer material carrying member and when the second density detection toner image is transferred from said image bearing member onto said transfer material carrying member.

21. An apparatus according to Claim 20, further comprising transfer means supplied with a voltage to transfer the toner image, wherein the transfer intensity is a voltage supplied to said transfer means.

22. An apparatus according to Claim 21, wherein said transfer means includes an electroconductive member for supporting the transfer material carrying member on the side opposite from a side for carrying the transfer material, and the voltage is applied to the electroconductive member.

23. An apparatus according to Claim 20,

wherein an image forming condition of said image forming means is controlled on the basis of an output of said density detecting means.

24. An apparatus according to Claim 22, wherein said electroconductive member includes a base member and an elastic layer between the base member and said transfer material carrying member.

25. An apparatus according to Claim 20, wherein said image forming means includes exposure means for exposure said image bearing member to form a latent image thereon, and said first and second density detection toner images are formed while changing exposure amount of said exposure means.

26. An apparatus according to Claim 25, wherein the exposure amount of said exposure means is controlled on the basis of an output of said density detecting means.

27. An apparatus according to Claim 20, wherein a plurality of the toner images are sequentially overlaid on said transfer material carrying member.

ABSTRACT OF THE DISCLOSURE

An image forming apparatus includes an image bearing member for carrying a toner image; an image forming means for forming a toner image on the image bearing member;a transfer material carrying member, for carrying a transfer material, wherein the toner image is transferred onto a transfer material carried on the transfer material carrying member or onto the transfer material carrying member; density detecting means for detecting a density of the toner image transferred to the transfer material carrying member; wherein a transfer intensity is smaller when the toner image for density detection is transferred onto the transfer material carrying member than when the toner image is transferred onto the transfer material carried on the transfer material carrying member.

684.2173 CI PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:	)	
	:	Examiner: Unassigned
TAKEHIKO SUZUKI, ET AL.	)	
	:	Group Art Unit: Unassigned
Appln. No.: Unassigned (Continuation of Appln. No. 08/521,835 filed August 31, 1995)	) :)	
Filed: June 20, 2000	) :	
For: AN IMAGE FORMING APPARATUS FOR CONTROLLING TRANSFER INTENSITY BY DETECTING TONER TEST IMAGES	) :) :	June 20, 2000

Assistant Commissioner for Patents
BOX PATENT APPLICATION
Washington, DC 20231

LETTER FORWARDING CORRECTED SHEETS OF THE DRAWINGS

Sir:

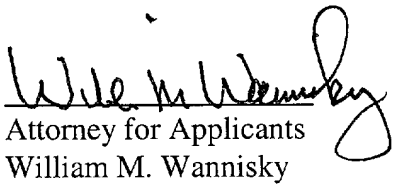
Enclosed are five sheets of formal drawings to be substituted for the corresponding drawing sheets presently on file in the above-identified application.

The new drawing sheets incorporate the changes required by the Official Draftsperson in the Notice of Draftsperson's Patent Drawing Review attached to the Official Action, dated November 21, 1997 in the parent application.

Favorable consideration hereof is earnestly solicited.

Applicants' undersigned attorney may be reached in our Washington office by telephone at (202) 530-1010. All correspondence should continue to be directed to our below listed address.

Respectfully submitted,



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WMW/kas/llp

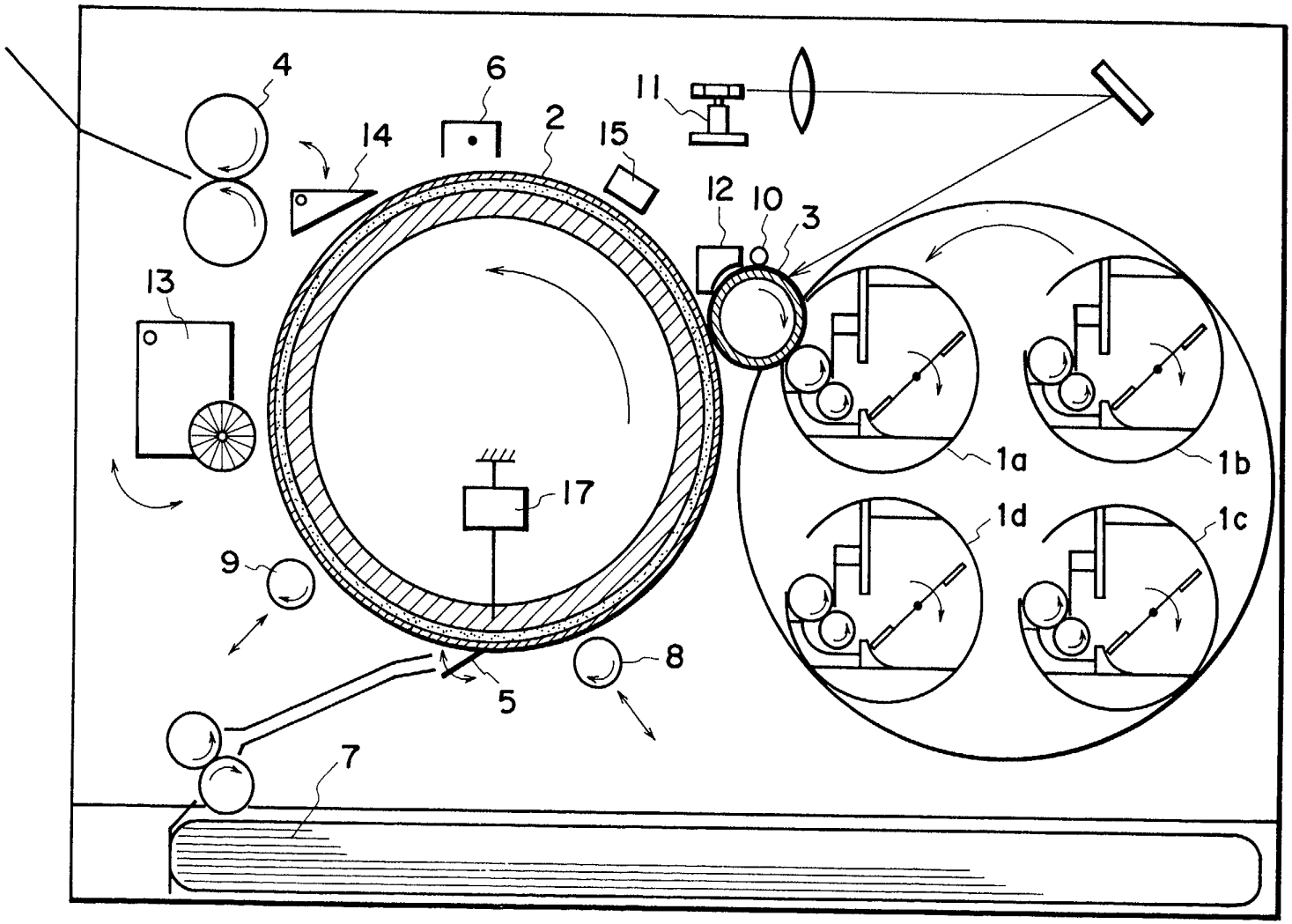

FIG. 1

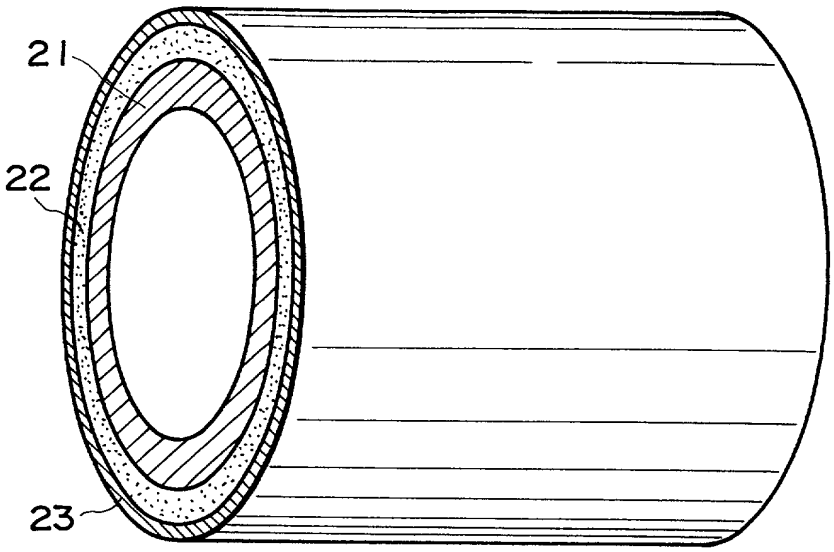
21
22
23

FIG. 2

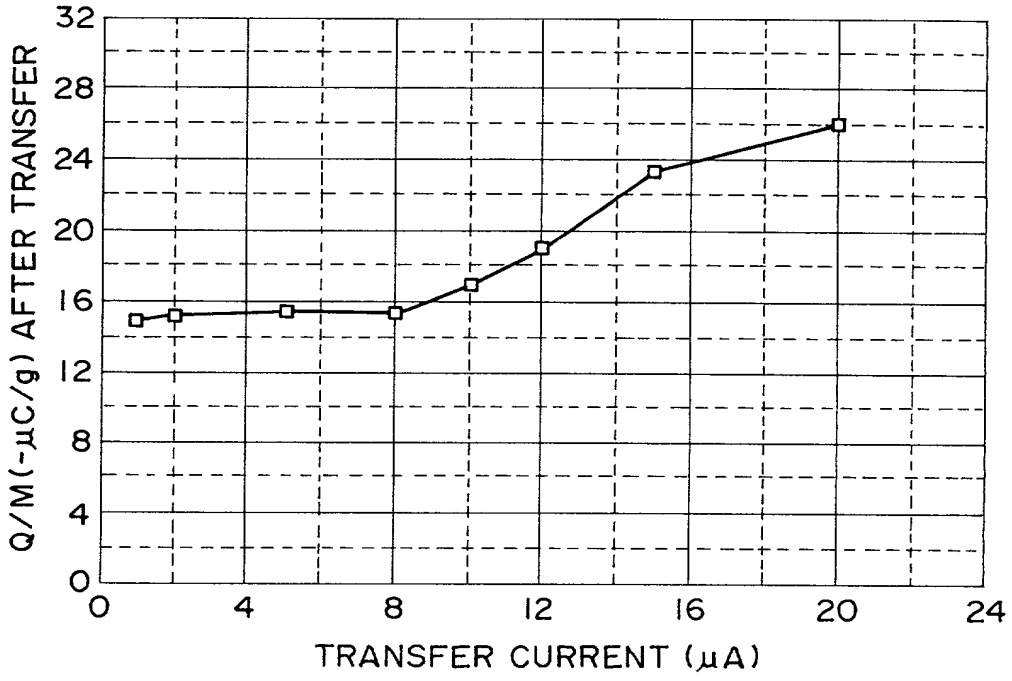
Q/M(-μC/g) AFTER TRANSFER
32
28
24
20
16
12
8
4
0
0
4
8
12
16
20
24
TRANSFER CURRENT (μA)

FIG. 3

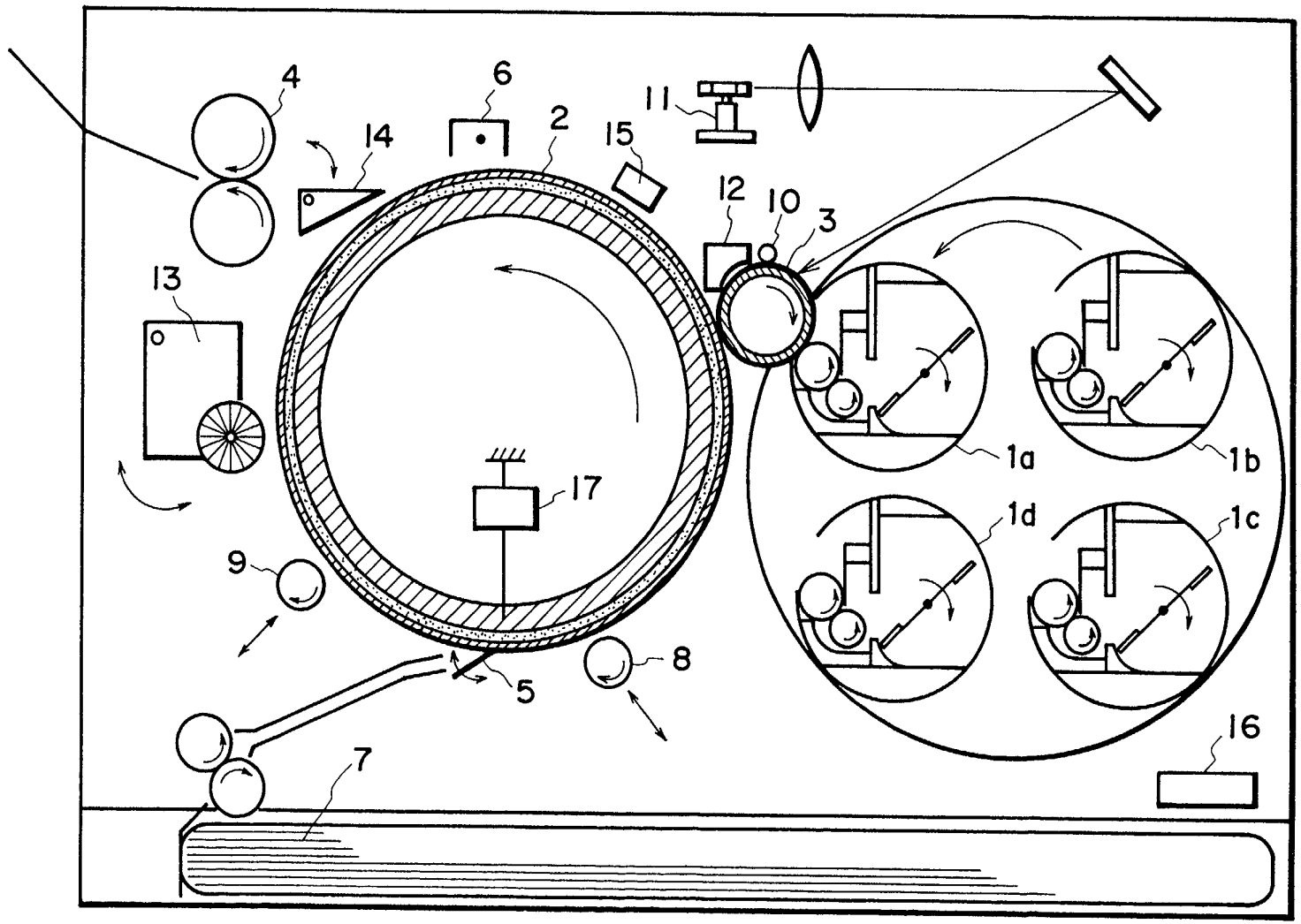

FIG. 4

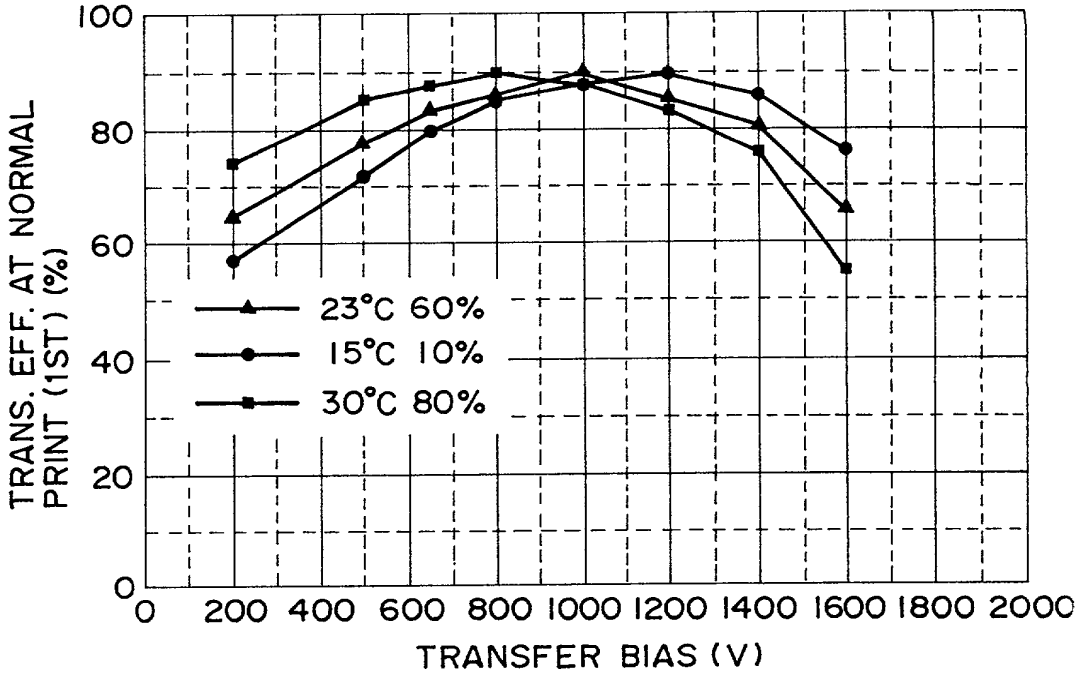
TRANS. EFF. AT NORMAL PRINT (1ST) (%)
100
80
60
40
20
0
0
200
400
600
800
1000
1200
1400
1600
1800
2000
TRANSFER BIAS (V)
23°C 60%
15°C 10%
30°C 80%

FIG. 5

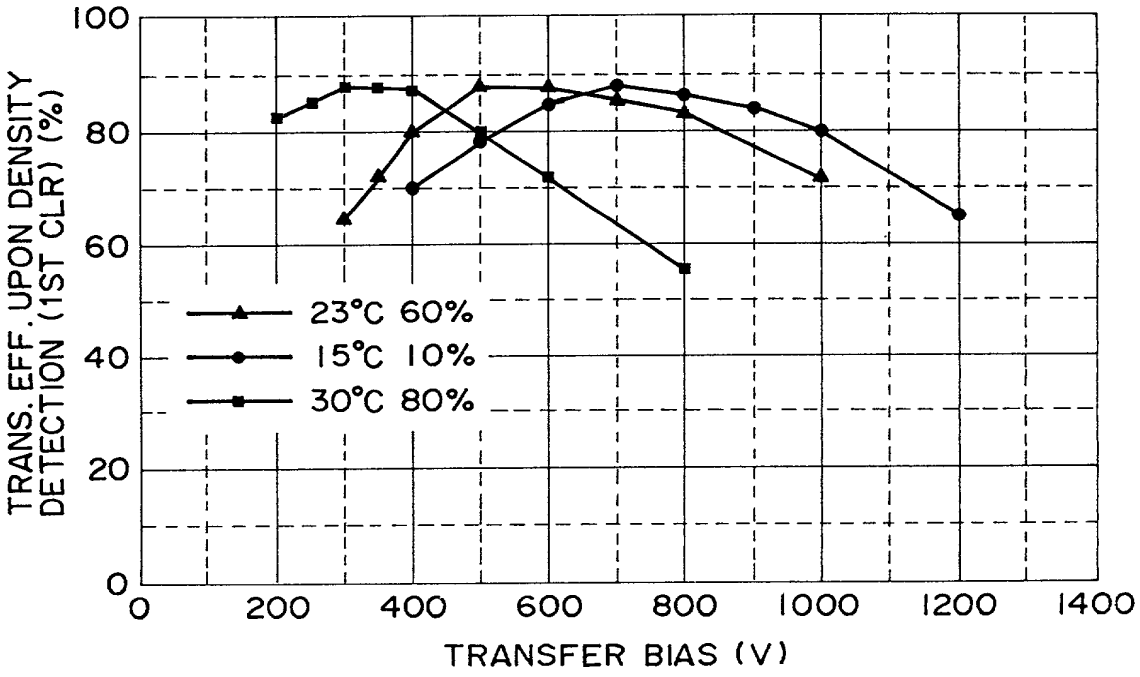
TRANS. EFF. UPON DENSITY DETECTION (1ST CLR) (%)
100
80
60
40
20
0
0
200
400
600
800
1000
1200
1400
TRANSFER BIAS (V)
23°C 60%
15°C 10%
30°C 80%

FIG. 6

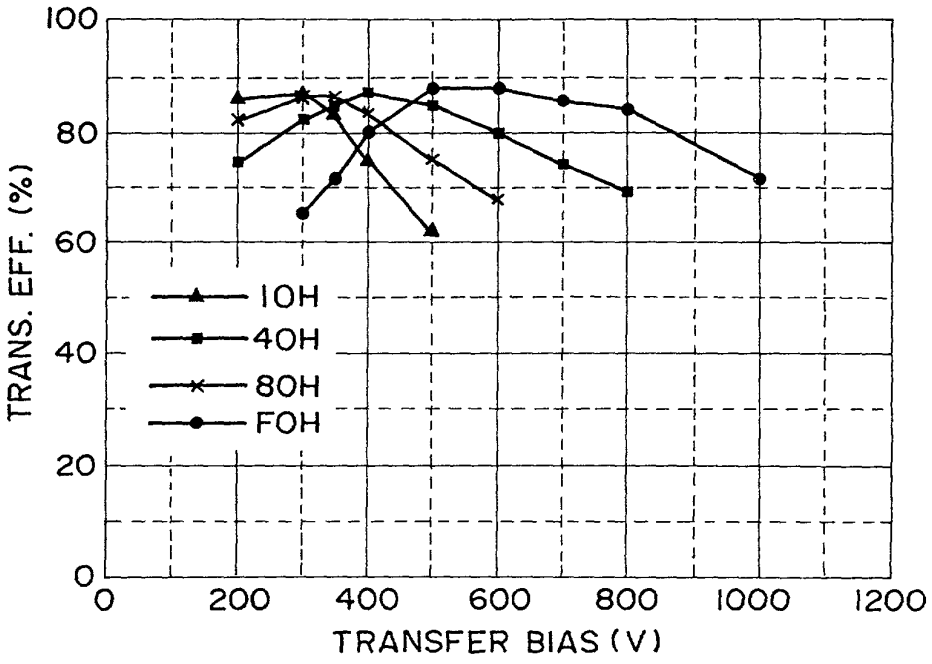
100
80
60
40
20
0
TRANS. EFF. (%)
10H
40H
80H
FOH
0
200
400
600
800
1000
1200
TRANSFER BIAS (V)

FIG. 7

COMBINED DECLARATION AND POWER OF ATTORNEY
FOR PATENT APPLICATION

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name;

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled AN IMAGE FORMING APPARATUS

_____

_____, the specification of which

☐ is attached hereto. ☒ was filed on 31/AUG/1995 as Application Serial No. 08/521,835

and was amended on _____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56(a).

I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate listed below and have also idenfified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Country	Application No.	Filed(Day/Mo./Yr.)	Priority Claimed (Yes/No)
Japan	206789/1994(Pat.)	31/AUG/1994	Yes

I hereby appoint Joseph M. Fitzpatrick(Registration No. 17,398), Lawrence F. Scinto (Registration No. 18,973), William J. Brunet (Registration No. 20,452), Robert L. Baechtold (Registration No. 20,860), John A. O'Brien (Registration No. 24,367), Nels T. Lippert (Registration No. 25,888), John A. Krause (Registration No. 24,613), Henry J. Renk (Registration No. 25,499), Peter Saxon (Registration No. 24,947), Anthony M. Zupcic (Registration No. 27,276), Charles P. Baker (Registration No. 26,702), Stevan J. Bosses (Registration No. 22,291), Edward E. Vassallo (Registration No. 29,117), Ronald A. Clayton (Registration No. 26,718), Lawrence A. Stahl (Registration No. 30,110), Laura A. Bauer (Registration No. 29,767), Leonard P. Diana (Registration No. 29,296), David M. Quinlan (Registration No. 26,641), Nicholas N. Kallas (Registration No. 31,530), William M. Wannisky (Registration No. 28,373), Lawrence Alaburda (Registration No. 31,583), Lawrence S. Perry (Registration No. 31,865), Robert H. Fischer (Registration No. 30,051), Christopher Philip Wrist (Registration No. 32,078), Gary M. Jacobs (Registration No. 28,861), Michael K. O'Neill (Registration No. 32,622), Bruce C. Haas (Registration No.32,734), Scott K. Reed (Registration No. 32,433), Scott D. Malpede (Registration No. 32,533), John A. Mitchell (Registration No. 19,032), Fredrick M. Zullow (Registration No. 32,452), Richard P. Bauer (Registration No. 31,588), Eric B. Janofsky (Registration No. 30,759), Warren E.Olsen (Registration No. 27,290), Abigail F. Cousins (Registration No. 29,292), Alan W. Fiedler (Registration No. 33,690), Jennifer A. Tegfeldt (Registration No. 31,310), Steven E. Warner (Registration No. 33,326), Thomas J. O'Connell (Registration No. 33,202), Aaron C. Deditch (Registration No. 33,865), Penina Wollman (Registration No. 30,816), David L. Schaeffer (Registration No. 32,716), Jack S. Cubert (Registration No. 24,245), Mark A. Williamson (Registration No. 33,628), John T. Whelan (Registration No. 32,448), Patricia M. Drost (Registration No. 29,790), Jean K. Dudek (Registration No. 30,938), Raymond R. Mandra (Registration No. 34,382) and Dominick A. Conde (Registration No. 33,856),

my attorneys to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith.

Address all correspondence to:

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COMBINED DECLARATION AND POWER OF ATTORNEY
FOR PATENT APPLICATION
(Page 2)

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that Such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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